

Laboratory Investigation 12

Chapter 24C: The Muscular System

Human Anatomy & Physiology: Muscular System

You may refer to pages 399-402
in your textbook for a general
discussion of the muscular system.
Time required: 120 minutes

Background Material

When a person wants to show the size of his muscles, we say that he is flexing his muscles. When we study anatomy, we discover that the action of flexing a muscle will always cause a joint to bend. For example, when you flex the biceps muscle in your upper arm, your arm will bend at the elbow. To extend your arm (straighten it at the elbow joint), your triceps muscle must contract. The biceps and triceps work together as a pair to allow you to bend and straighten your arm. Two other groups of muscle pairs include the deltoid and the pectoralis major, which are also involved with moving the arm, and the hamstrings and quadriceps femoris groups that move the leg.

Materials Part 1

microscope; microscope slides of muscle tissue; colored pencils

Part 1: Microscopic Structure of Muscle

The muscles mentioned above are all skeletal muscles that function to move the bones. Visceral muscle and cardiac muscle differ from skeletal muscle in both structure and function. The differences in structure can be observed with the microscope.

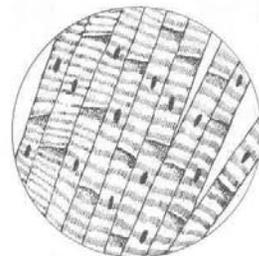
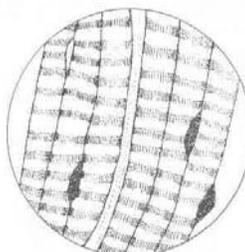
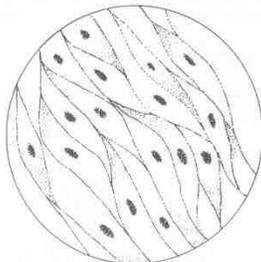
Examine a permanent slide of skeletal, cardiac, and visceral muscle. Refer to the photographs on page 399 of your textbook as you examine the slide. Begin your observation with the skeletal muscle. Since all three muscle samples are on the same slide, refer to the slide label to determine which section of tissue is the skeletal muscle. The three types of muscle should be mounted on the slide in the same order as they are listed on the slide label. After you have focused the skeletal muscle under low power, switch to high power for a detailed study of the tissue. Notice that the muscle appears to consist of many long, thin fibers packed tightly together. This arrangement produces the grain of the muscle. The dark spots are the nuclei of the cells. If you look carefully, you may see striations extending like fine, wavy lines across the grain of the muscle. Study the drawings below in this lab and label the one that you think is skeletal muscle.

Now observe the cardiac muscle. Use low power first and then high power. Cardiac muscle also consists of long fibers, but they appear to be somewhat thicker than the skeletal muscle fibers, and the nuclei are larger. Study the drawings below in this lab and label the one that appears to be cardiac muscle.

Continue your study of muscle by examining the visceral (smooth) muscle under low power first and then under high power. Notice that the fibers are arranged in a somewhat more irregular pattern than those of skeletal muscle and cardiac muscle. Label the drawing below and label the one that appears to be visceral muscle. Check your labels on all three drawings and observe the tissues again if necessary to make sure that you have correctly labeled each one.

Part 1: Microscopic Structure of Muscle Diagrams

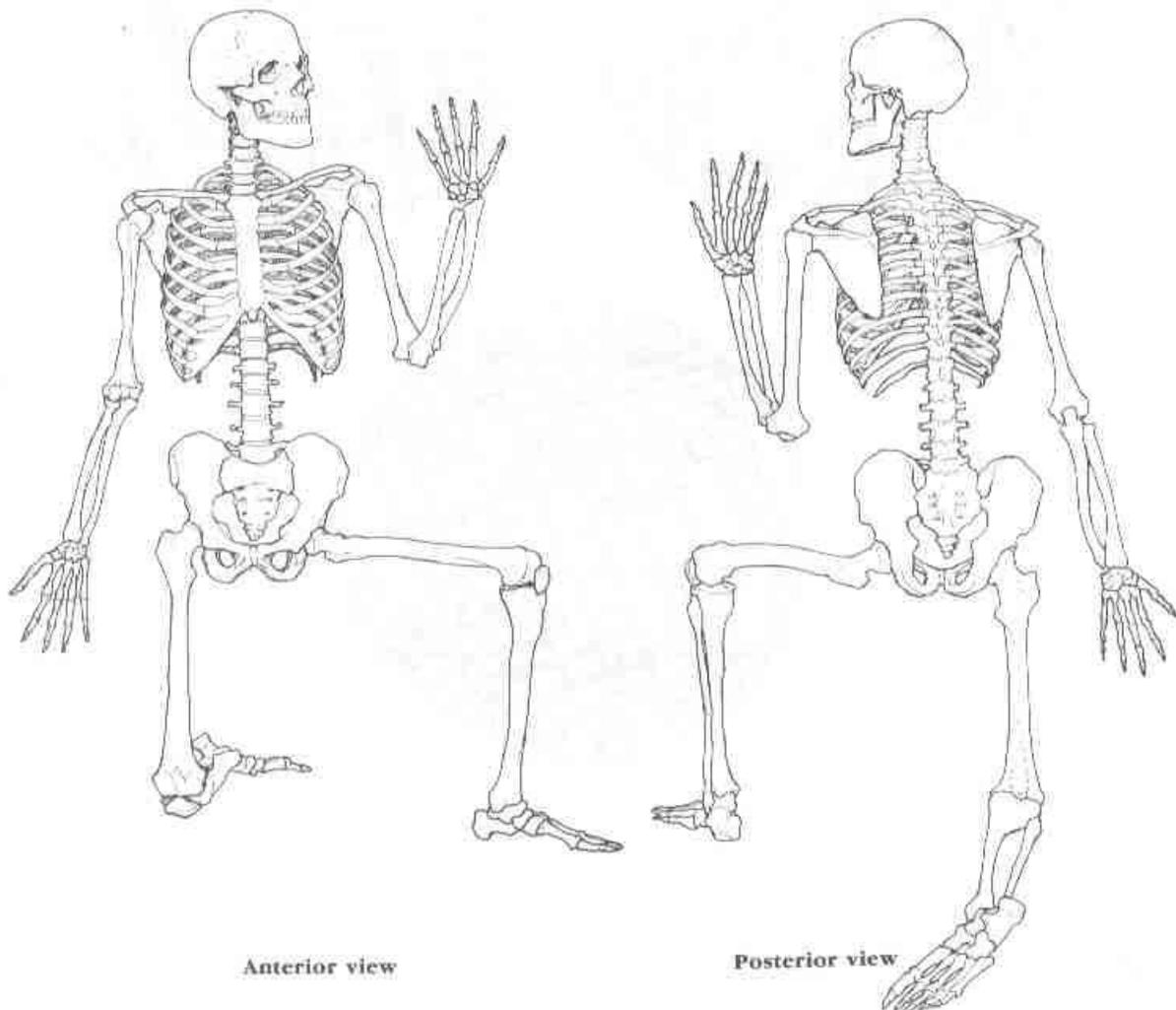
Label the type of muscle (either skeletal, cardiac, or visceral) pictured. Also label nuclei and striations.



Identifying Human Muscles

Draw each of the muscles listed below in its proper position on either the anterior or posterior view of the skeleton and color it as indicated. If a muscle is visible on both sides of the body, draw it on both views (anterior and posterior). List the function of each muscle next to its name on the chart.

Name of Muscle	Color	Function
Trapezius	yellow	
Gastrocnemius	black	
Masseter	dark green	
Intercostal muscles	dark blue	
Latissimus dorsi	brown	
External oblique	purple	
Gluteus maximus	orange	
Biceps	red	
Triceps	white (draw outline)	
Deltoid	light green	
Pectoralis Major	light blue	
Hamstring group	gray (use pencil lead)	
Quadriceps femoris group	blue ink	

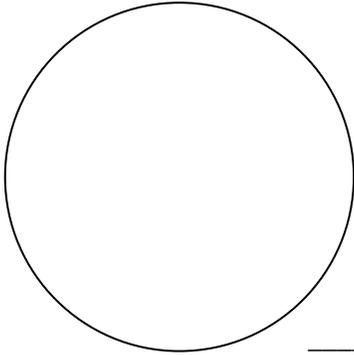


Procedures Part 1 - Microscope

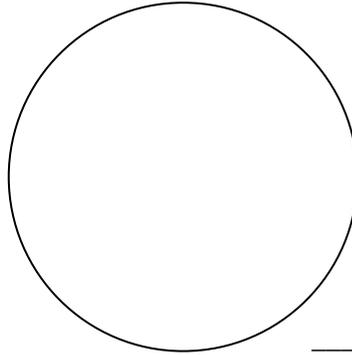
1. Observe and draw a preserved slide of a section of skeletal, visceral, and cardiac muscle.
2. Fill in the chart below, which deals with the three types of muscles.

Drawings Part 1

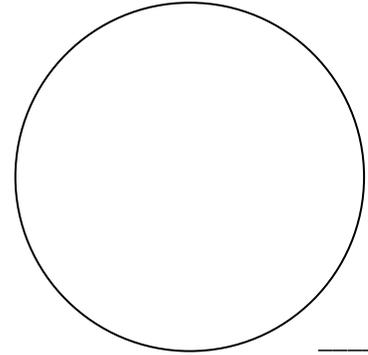
Human Skeletal Muscle



Human Visceral Muscle



Human Cardiac Muscle

**Three Types of Muscles Chart**

	Skeletal	Visceral	Cardiac
Voluntary or Involuntary?			
Striated or smooth?			
Where is it found?			
What does it control?			

Observations Part 1

1. Which of the three types of muscle appears to have the most parallel fibers? _____
2. Which of the three types of muscle has the most irregular fibers? _____
3. Which of the muscle types appears to have the largest nuclei? _____
4. Which of the types of muscle appears to consist of fibers that connect side to side like the off ramp of an interstate highways?

Materials Part 2 – Experiment: Control of Muscles

clock with a second hand

Procedures Part 2 – Experiment: Control of Muscles

Blink your eyes three times, then immediately begin holding your eyes open as long as you can. Do not roll your eyes around as you hold them open. Have a friend time you.

- How long were you able to keep your eyes open without blinking? minutes ____ seconds
- Rest your eyes for at least five minutes with normal blinking and eye movement. Try the experiment again. How long were you able to keep your eyes open? minutes ____ seconds
- Rest your eyes and try the experiment again. How long were you able to keep your eyes open? minutes ____ seconds

What is the average amount of time you can keep your eyes open? minutes ____ seconds

Compare your average to the average amount of time that other people in your class are able to keep their eyes open without blinking. Is there a significant difference? _____

If there is a significant difference, what do you believe could account for it?

Analysis and Conclusions for Part 2 – Experiment: Control of Muscles

1. What is a voluntary action? _____

2. List several examples of muscle actions that are voluntary.

3. What is an involuntary action? _____

4. List several examples of muscle actions that are involuntary.

5. The reaction of blinking your eyes is stimulated when the surface of the eye begins to dry out. This action of blinking your eyes is controlled by muscles.
Are the muscles that blink your eyes voluntary, involuntary, or both? _____
Why did you choose the answer you gave? _____

List several other actions that are controlled in the same way that eye blinking is. _____

Background Material Part 3: Chicken Wing Structure

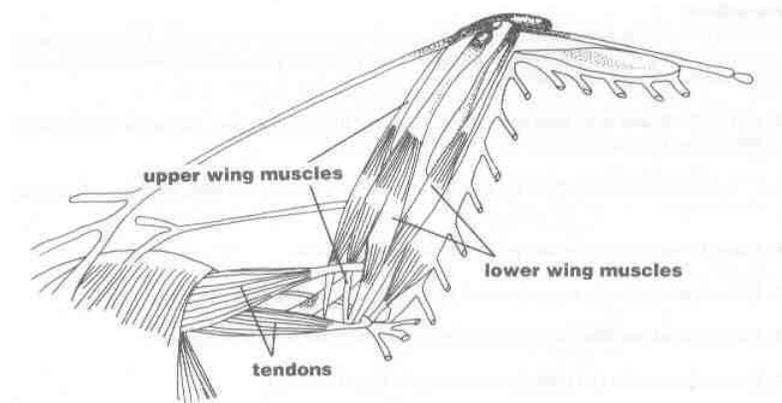
Vertebrates all have internal skeletons with muscles attached to parts of the skeleton. By examining a chicken wing, you can see the various parts of this vertebrate's skeleton and muscular systems. These parts are similar to those found in humans.

Materials Part 3: Chicken Wing Structure

Chicken wing, raw	Gloves
Goggles	Lab apron
Dissecting pan	Microscope, compound
Dissecting pins	Microscope slides and coverslips
Dissecting probe	Paper towels
Dissecting scissors	Scalpel
Forceps	Toothpicks

Procedure Part 3: Chicken Wing Structure

1. *CAUTION: Put on goggles, gloves, and lab apron before you begin this activity. Keep hands away from face when doing this activity. Wipe away any spills and pick up dropped objects to prevent slips and falls.* Put the chicken wing in the dissecting pan.
2. *CAUTION: Be sure to cut away from yourself.* Using the dissecting scissors, cut under the skin from the exposed end of the upper wing to the first joint.
3. Pull the skin completely from the muscles and joints of the chicken wing, using your fingers and the forceps.
4. Rinse the wing with water and gently dry with paper towels.
5. Use a dissecting probe to gently touch the muscles to observe their structures.
6. Find the tendons. They are the white cords that attach the muscle to the bone.
7. Observe the muscles and tendons of the wing.



Muscles and Tendons of a Chicken Wing

8. Move the lower part of the wing while holding the upper portion still. Observe the pair of opposing muscles controlling this movement.
9. Move the wing tip while holding the lower wing still. Observe the pair of opposing muscles controlling this movement.
10. *CAUTION: Be sure to cut away from yourself.* Use the scalpel to cut the muscles from the bones.
11. Investigate the joints of the wing. Observe the ligaments. These are the tough, white cords that connect two bones.

12. Separate the bones at the joints by twisting the bones in opposite directions. Observe the cartilage that covers the bone.

CAUTION: Wash hands thoroughly when finished to avoid Salmonella.

Analysis and Conclusions Part 3: Chicken Wing Structure

1. What could be the function of the cordlike structure of the tendons?

2. What is a function of cartilage?

3. Describe how the muscles, tendons, bones, ligaments, and joints work together to move the lower wing.

Background Material Part 4: Muscle Fatigue

Muscles work with the skeletal system to move parts of your body. In order for the muscles to work, they must have a supply of sugar, which can be burned to provide energy. However, when a muscle uses up its supply of available energy, it begins to ache and cramp rather than work properly. This cramping is called *muscle fatigue*. The better physical condition a person is in, the longer his or her muscles can work without experiencing muscle fatigue.

Materials Part 4: Muscle Fatigue

clothes pins (the type held together with a metal spring)

Procedure Part 4: Muscle Fatigue

You can do a very simple test to demonstrate muscle fatigue. Obtain a clothes pin that is held together with a metal spring. Hold the ends of the clothespin between the tips of your index finger and your thumb. Begin pinching the clothespin open and then allowing it to close slowly. Continue this action as many times as possible, counting the number of times you can open the clothespin. Stop when the muscle between your thumb and index finger begins to cramp.

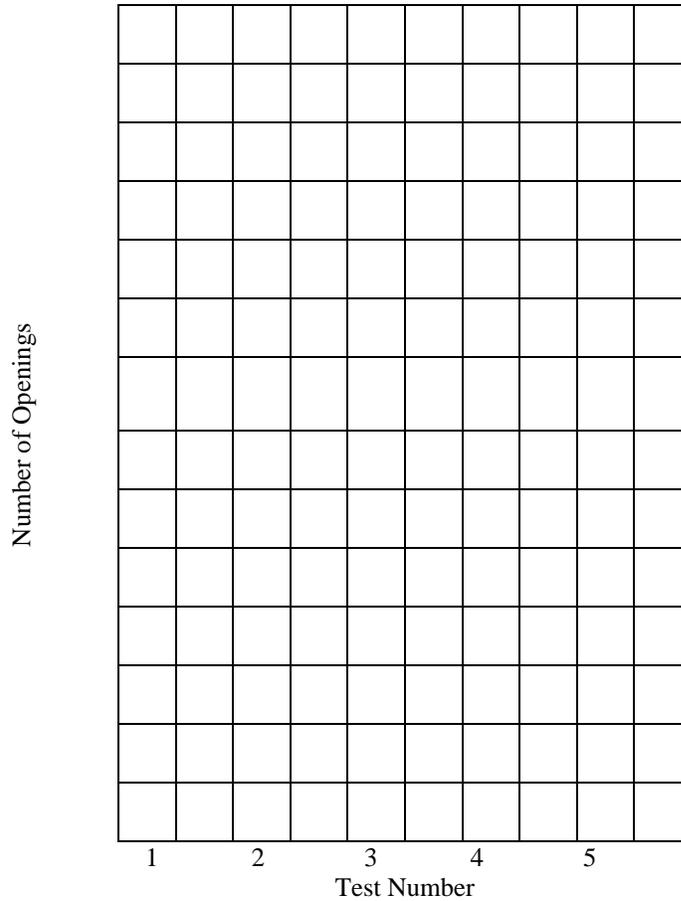
How many times were you able to open and close the clothespin? _____

Wait two minutes and try this test again. Repeat the test a total of five times, allowing a two-minute rest between each test. For each test, record the number of times you were able to open and close the clothespin. Record your results in the table.

Table of Muscle Fatigue	
Test	Number of Openings
Test 1	
Test 2	
Test 3	
Test 4	
Test 5	

Analysis and Conclusions Part 4: Muscle Fatigue

1. Make a graph that shows the number of times you were able to open and close the clothespin in each trial.



2. What does your graph indicate about the onset of muscle fatigue with each succeeding trial?

3. If a person is involved in some unaccustomed physical activity for several hours, what happens to his or her ability to perform the activity?
